The problem has then found a partial solution, inasmuch as we have traced the growth of Zuñi communities and the ancient isolated character of their habitat. On the other hand the evidences for cultural isolation lie only in the development of such items as pottery designs of specifically Zuñian character, the general nature of their culture-history as a whole showing a common growth with their Rio Grande neighbors.

The few data now at hand for the Southwest suggest a marked uniformity of culture throughout that area from the earliest times, with the gradual individualization by the several tribes of certain minor culture traits.

Whatever its specific results, this study has shown that the method of assumed seriation can be applied to archeological phenomena. So far as the method is concerned, the novelty lies in its application to American culture-history.

The full data will be published in the *Anthropological Papers of the American Museum of Natural History.*

[1] Fewkes, J. W., *J. Amer. Ethn. Arch., Boston,* **1,** 1891.

[2] Kroeber, A. L., *Anthrop. Papers Amer. Mus. Nat. Hist., New York,* **18,** 1916; these PROCEEDINGS, **2,** 1916, (42–45).

[3] Nelson, N. C., *Amer. Anthrop.,* N. S., **18,** (159–180).

[4] Kidder, A. V., *Memoirs Amer. Anthrop. Assn.,* **2,** (407–462).

[5] Kidder, A. V., these PROCEEDINGS, **2,** 1916, (119–123).

THE AGE OF THE BOLIVIAN ANDES

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During the joint explorations of Messrs. J. T. Singewald, Jr., and B. L. Miller in South America extending over several months in 1915 fossil plants were collected at two localities in the highlands of Bolivia. One, an entirely new locality at Corocoro[1] near the western edge of the *altiplanicie* or high plateau of Bolivia and the other at Potosi in the *Cordillera Real* or Eastern range of the Andes, from which fossil plants had previously been described by both Engelhardt[2] and Britton.[3]

In the series of volcanic tuffs which contain the fossil plants at the latter locality and from a slightly lower level a few marine fossils were collected and as the age of these tuffs has never been determined and as they throw an unexpected light on the age of the eastern range of the Bolivian Andes and of the extensive mineralization of that region a brief preliminary announcement seems desirable.

Although the textbooks tell us that the Andes date from Cretaceous

times the evidence is accumulating that their final elevation was only accomplished in the late Tertiary or even in the Pleistocene and there is some evidence that this upward movement is still going on. Thus Steinmann considers the dioritic rocks of the copper belt as of late Tertiary age and Stille[4] states that the uplift of the eastern cordilleras in Colombia must have been in the late Tertiary because of the part taken in the movement by the Miocene Honda beds. Neither Engelhardt nor Britton in their studies of the fossil plants from Potosi venture beyond Tertiary in their age determinations. In my own work I have always regarded this flora as probably of Pliocene age because of its resemblance to the existing flora in this general region. The collections made by Singewald and Miller but emphasize the opinion that the flora is very young and I am not yet sure that it will not eventually have to be considered Pleistocene.

More spectacular than the floral evidence is that of the fauna which is found in the same series of tufaceous materials at a somewhat lower level. The only determinable form is a new species of *Discinisca* which has been determined by Professor Schuchert, who will describe it in the final report on this region. Professor Schuchert states that this form is related to the existing *Discinisca lamellosa* (Broderip) which is found in shallow water along the west coast of South America from Panama to Chile, and that it cannot be older than Miocene and may be Pliocene or Pleistocene.

The extreme youthfulness of these beds indicated by the Brachiopod and confirmed by the more extensive evidence furnished by the flora shows that the sea deposited a part of these strata in late Tertiary or Pleistocene time and since that time there has been differential vertical movements amounting to a minimum of 13,500 feet.

The fossil plants denote a much more humid climate than prevails today in this region. For example at Corocoro which now lies at a little over 13,000 feet above sea level, the country is practically a treeless desert. The fossil plants from this locality include a fern (*Polystichum*), fruits of *Terminalia* and *Copaifera*, both tropical trees of the eastern subandean hills and Amazon Basin; leaves of *Mimosa arcuatifolia* Engelhardt, *Mimosites linearis* Engelhardt, *Acacia uninervifolia* Engelhardt, and *Cassia ligustrinoides* Engelhardt, the last four common to Potosi and suggestive of the existing deciduous forests of the so-called Pantanales region of the eastern plains of Bolivia.

If the moisture carrying winds were from the east at that time as they are at the present time, the lowering of the eastern Andes would enable such a flora to flourish in the present inter montane region.

The flora from Potosi is extensive and not yet fully elaborated. It includes about sixty species and the following genera are represented: Acacia, Acrostichum, Amicia, Caesalpinia, Calliandra, Capparis, Cassia, Copaifera, Cuphea, Dalbergia, Desmodium, Drepanocarpus, Enterolobium, Escallonia, Euphorbia (?), Festuca, Gaylussacia, Gymnogramme, (?), Hedysarum, Inga, Lomariopsis, Lonchocarpus, Machaerium, Mimosa, Mimosites, Myrica, Myrteola, Passiflora (?), Peltophorum, Pithecolobium, Platipodium, Poacites, Podocarpus, Polystichum, Porliera, Ruprechtia, Sweetia, Terminalia, and Weinmannia.

A perusal of these genera, already recognized, is sufficient to convince any botanist or indeed any visitor to the region, that this flora is very different from that now found in the Potosi region. While the botanical exploration of the present Bolivian flora leaves much to the future it is obvious that if we seek for representatives of this fossil flora in the recent flora of Bolivia, nearly all the genera are to be found represented in the more or less well watered country east of the present eastern range, and particularly on the lower eastern slopes. Moreover most of the fossil species are very close to still existing species of the latter region and this resemblance is so close that I cannot conceive of this flora being older than Pliocene.

There is then definite evidence that parts of the high plateau and of the eastern Cordillera stood at sea level in the late Tertiary.

[1] Singewald, J. T. Jr., and Miller, B. L., *Engin. Min. J., New York*, **103**, 1917, (171–176).

[2] Engelhardt, H., *Dresden, Sitz-Ber. Isis*, 1887, Abh. 5, (36), 7 figs.; *Ibid.*, 1894, Abh. 1, (1–13), 1 pl.

[3] Britton, N. L., *New York, Trans. Amer. Inst. Min. Engin.*, **21**, 1893, (250–259).

[4] Stille, H., Geol. Studien im Gebiete des Rio Magdalena, *von Könen Festschrift*, 1907, p. 356.

LARGE CURRENT-RIPPLES AS INDICATORS OF PALEOGEOGRAPHY

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In the Eden and in parts of the Richmond Group (Upper Ordovician) large ripples, measuring 50 to 150 cm. from crest to crest, are rather common throughout the region of the Cincinnati Anticline, in Kentucky,[1] Indiana,[2] and Ohio.[3] From a careful study of very numerous rippled layers of these formations in southwestern Ohio and north-central Kentucky, of 13 rippled layers in the Brassfield formation of east-central Kentucky[4] and of one in the Blackhand formation (Mississippian) of eastern Ohio,[4a] the following data were obtained: